Nitrogen Management In Rice: Rates, Timings, Sources

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Introduction

Nitrogen (N) fertilization accounts for a large percentage of inputs for rice production. The potential for an economic return on the N investment is also large. Nitrogen is dynamic in nature, and thus it must be managed appropriately to provide the greatest economic return. The knowledge base of N interactions with the soil and plant system continues to increase, especially with respect to midsouthern USA environments. Nitrogen application at the appropriate rates has been encouraged historically; however, in recent years, variety susceptibility to lodging has shown the necessity to fine-tune N rates to minimize lodging. Application source and timing are very closely related in the production system. Sources applied in environments that promote N loss via volatilization and/or nitrification/denitrification must be applied as close to the establishment of permanent flood as possible (< 3 days) to maximize efficiency. However, products that are stabilized from N loss provide the opportunity for growers that can't establish a flood in a few days to still maximize N efficiency even at applications of 8 to 10 days prior to permanent flood establishment. The objective of this presentation will be to disseminate several N management studies to aid growers in decision making regarding N application for rice.

Materials and Methods

Multiple N field and laboratory trials have been conducted in Mississippi, Louisiana, and Arkansas in recent years, each with the overarching goal of improving N management strategies. Specifically, volatilization trials have been conducted in laboratory and field environments to evaluate products that claim to minimize volatilization losses. Furthermore, laboratory and field trials have been conducted to determine the nitrification/denitrification potential of several soils representative of where rice is produced in the midsouthern USA. Additionally, trials have been conducted to evaluate products that can potentially minimize nitrification and hence denitrification loss. Finally, traditional N rate trials have been conducted for the numerous new cultivars that have been released in recent years. This gives growers a a N rate range to reach 95% relative yield potential and greater and also provides information regarding a cultivar's ability to resist lodging.

Results

Laboratory and field trials conducted in Mississippi, Louisiana and Arkansas have all proven that only one active ingredient is being marketed that effectively minimizes volatilization potential and hence can improve nitrogen use efficiency when volatilization conditions are present. Agrotain®, Arborite®, and N-FIXX® are trade names that all contain the active ingredient N-(n-butyl) thiophosphoric triamide, known as NBPT. Regardless of the trial, NBPT when applied at the appropriate rate has effectively minimized volatility. Nutrisphere®, Upgrade®, N-ZONE®, STAY-N®, and N-STAY® failed to minimize volatilization loss potential. Additionally, our studies indicate that coarse-textured soils such as the silt loams tested in Mississippi, Louisiana and Arkansas tend to lose more N to volatilization compared to fine-textured soils such as the clay soils in Mississippi. Grain yield loss on soils that exceed 20% loss of N to ammonia volatilization have also shown yield loss in excess of 15% when urea is applied and a flood is not established until 10 days after application.

Laboratory trials indicated that soils differ in nitrification potential. Various Mississippi soils were evaluated and resulted in half-lives of ammonium ranging from less than 5 days to approximately 9 days. Approximately 50% of the N that contributes to grain yield can be lost when urea is applied, a rainfall event occurs after application, and a permanent flood cannot be established within 7 to 10 days after application. Chemical nitrification inhibitors, including dicyandiamide (DCD), have shown some ability to decrease nitrification; however, it has not provided as much stability as a physical coated product (Agrium 43% N) has. In two years of research, Agrium 43% provided acceptable stability from the nitrification/denitrification process. Laboratory procedures are currently underway to further investigate the potential for this product.

Nitrogen response trials have provided information regarding N rates that are needed to optimize cultivar performance. CL151 has been prone to lodging since its release. Multi-location trials have shown that CL151 can achieve 95% of its yield potential with N rates that range from 90 to 135 lb N/acre, depending on the location. These rates also result in less lodging. This is in general a substantial reduction in N relative to cultivars that have preceded it (150 to 180 lb N/acre).

Summary

Nitrogen management is critical to the economic sustainability of the high input, mechanized rice cultural system used in the USA. Regional research efforts have provided up-to-date management recommendations for improving N use efficiency. Product testing is important so growers can make informative decisions on what products to employ and how they are best utilized in their system. Knowledge of the soil/plant interactions is critical and continued investigations are critical to further develop best management practices for rice production. Δ

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